MCS 260 Exam 2 13 November 2015

Name: ____

- Do not start until instructed to do so.
- In order to get full credit, you need to show your work.
- You have 50 minutes to complete the exam.
- Good Luck!

Problem 1	__________/15
Problem 2	__________/10
Problem 3	__________/21
Problem 4	__________/21
Problem 5	__________/25
Problem 6	__________/8

Total __________/100

Problem 1 *(15 points)* Briefly describe what is a network protocol. Secondly, describe what the SMTP protocol is used for.

Answer. A network protocol defines a syntax and semantics of messages which are exchanged between computer systems. A network protocol is an agreed upon format for the sequence of bits exchanged between computers, together with a meaning attached to each message. The SMTP protocol is used for email submission. The client sends messages containing data like the recipient, sender, and email content. The server responds with messages informing the client if the email is formatted properly and the email addresses are acceptable.

Problem 2 *(10 points)* Explain the difference between top-down and bottom-up design.

Answer. Something like what is on the Day 27 page. Top-down divides a task into subtasks and bottom-up builds components and then links components together to form larger components.

Problem 3 *(21 points)* Write a python function which takes as an argument the name of a file and returns the number of lines in the file which have length between 10 and 20 characters. That is, $10 \leq len(line) \leq 20$.

Answer.

```
def foo(filename):
    with open(filename, ”r”) as f:
        cnt = 0
        for line in f:
            if len(line) >= 10 and len(line) <= 20:
                cnt += 1
        return cnt
```

Problem 4 *(21 points)* Write a python class `Thermostat` which has one property called `target_temperature` and two methods: an initialization method which takes an argument for the initial target temperature and one method `turn_on_heat` which takes an argument for the current temperature and returns true if the current temperature is at least 3 degrees below the target temperature and false otherwise. *Hint: the solution I wrote consists of 5 lines of code. Yours might be slightly longer but should not be significantly longer.*

Answer.

```
class Thermostat:
    def __init__(self, temp):
        self.target_temperature = temp

    def turn_on_heat(self, current):
        return current + 3 < self.target_temperature
```

Problem 5 *(25 points)*

```
class QuadraticPolynomial:
    def __init__(self, a, b, c):
        #Initializes a quadratic polynomial from the coefficients
        #a, b, and c where the polynomial is ”ax^2 + bx + c”.
        #a is required to be positive.
        assert (a > 0)
        self.a = a
        self.b = b
        self.c = c

    def somemethod(self, x, y):
        if self.a * x**2 + self.b * x + self.c <= y:
            return True
        else:
            return False

    def anothermethod(self):
        d = self.b**2 - 4 * self.a * self.c
        if d >= 0:
            return [ (-self.b + math.sqrt(d))/(2*self.a),
                     (-self.b - math.sqrt(d))/(2*self.a)]
        else:
            return []
```

Explain what `somemethod` and `anothermethod` are doing. Then write two python functions (not methods) which take as a parameter a single `QuadraticPolynomial` and decides if the origin (0,0) is above the polynomial (that is, test if (0,0) is above where the polynomial crosses the y-axis). You should write two different python functions carrying out this same task, one function which uses `somemethod` and another function which uses `anothermethod`. You can assume that $a > 0$ (so that the polynomial opens upward). *Hint: the version using `somemethod` can be done in a single line and the version using `anothermethod` can be done using four or five lines.*

Answer. `somemethod` takes an (x, y) value. It then computes the value of the polynomial at x and compares it with the passed in y value. To test zero above or below it is enough to just pass in $(0, 0)$.

```
def option1(poly):
    return poly.somemethod(0, 0)
```

Answer. `anothermethod` computes the roots of the polynomial and returns them as a list. If the discriminant is negative there are no roots so the function returns the empty list and otherwise returns the two roots. To test $(0,0)$, there are three cases. Case 1: there are no roots. Then $(0,0)$ will be below since $a > 0$ the poly will open upward. Case 2: zero is between the roots. Then $(0,0)$ is above since the poly opens upward. Case 3: zero is not between the roots. Then $(0,0)$ is below since the poly opens upward.

```
def option2(poly):
    r = poly.anothermethod()
    if len(r) > 0 and r[1] <= 0 and r[0] >= 0: # zero between roots
        return True
    else: # Zero not between roots or there are no roots
        return False
```

Problem 6 *(8 points, 2 points each)* Mark whether each statement below is True or False and add one sentence of explanation why it is True or False. **You must have a correct explanation to get full credit!!!**

(a) The python expression `[2*x for x in range(5)]` produces the list `[0, 2, 4, 6, 8, 10]`.

Answer. False, x ranges through zero through four and is doubled so 10 should not be in the list.

(b) After a python object is created, new properties cannot be added to the object.

Answer. False, python can add new properties to an object at any time.

(c) In python, when calling a function every argument is passed call-by-reference.

Answer. False, integers, strings, and floating point are passed call-by-value and objects, lists, and dictionaries are passed call-by-reference.

(d) In the k-means clustering algorithm, points are classified by their distance to the nearest centroid.

Answer. True, but only for one iteration. As the clustering iterates, points can change their classification by becoming closer to a different cluster center.